To the Proprietors of the UNIVERSAL MAGAZINE.

GENTLEMEN,

Your ready Conveyance of uſeful Knowledge to the Public gives me Expectations of finding the following Draughts *and* Explanations *of the* beſt Kinds *of* Microſcopes *in your* Magazine, *as ſoon as you ſhall ſee convenient. By which I intend to make that* uſeful *Inſtrument* eaſy, *for the Inſtruction of ſuch, particularly, as deſire to ſearch into the* Wonders *of the* minute Creation; *though they are not acquainted with* Optics.

The MICROSCOPE made eaſy,

With a true Repreſentation *of their* beſt Kinds, *and of ſome* Objects, *in a large* Copper-Plate *neatly engraved.*

A *Microſcope* is an inſtrument contrived by art, to make ſmall objects appear larger than they do to the naked eye, by the help of convex glaſſes. An invention not to be traced higher than the year 1621; ſince which time it has been greatly improved. So that now we have both ſingle and double *microſcopes*; and theſe again are ſubdivided by other names.

The *ſingle microſcope* has but one *lens* or ſmall glaſs, and ſhews the object nearer at hand, and rather more diſtinct. The *double* is a combination of two or more ſmall glaſſes, and repreſents a larger field, or more of an object, equally magnified, at one view.

‘One remarkable difference, ſays Mr. *Henry Baker*, in the effect of theſe two inſtruments is, that an object, viewed through a *ſingle* convex glaſs, appears magnified, in the ſame poſition exactly, as when ſeen by the naked eye; but when viewed thro' a *double microſcope*, compoſed of *three* convex glaſſes, all parts of it become inverted; that is, the top of the object appears at bottom; the right ſide, on the left; and every part in the place moſt oppoſite to its natural and true poſition: the lights and ſhades being alſo inverted, the ſinking parts appear to riſe, and the riſing parts to ſink in.’ Yet it is difficult to determine which of theſe to recommend, ſince each affords a different kind of pleaſure. And, therefore, I have given you the ſpecimens of each ſort under divers *forms*, with their deſcriptions.

The *ſingle pocket microſcope*, fig. I. in the *plate*, gives honour to Mr. *Wilſon*, its inventor, and is thus deſcribed: AA. BB. ſhew the form of its body made of ſilver, braſs, or ivory, *&c.* CC, a long-threaded male ſcrew turning into the ſaid body. EE, three thin braſs plates within the body; one of which is bent ſemicircularly in the middle, ſo as to form an arched cavity to receive a glaſs tube: the other two are flat, and receive and hold the ſliders between them. F, a piece of wood or ivory arched in the manner of the ſemicircular plate, and cemented thereunto. G, the other end of the body, where a hollow female ſcrew is adapted to receive the different magnifiers. H, a ſpiral ſpring of ſteel between the end G and the braſs plates, to keep the plates in a right poſition, and to counteract againſt the long ſcrew C C. The turned handle is made to ſcrew on and off at pleaſure.

Note. To this *microſcope* belong ſeven different magnifying glaſſes, the loweſt number being the greateſt magnifier: ſix of them are ſet in ſilver, braſs, ivory, *&c.* as in No. 14. The ſeventh is like a little barrel, No. 15. to be held in the hand for the viewing any larger object. No. 1. Is a flat ſlip of ivory, called *a ſlider*, with four round holes through it, wherein to place objects between two glaſſes or pieces of *Muſcovy* talc. No. 19. Is a *forceps* or pair of plyars for taking up objects, and adjuſting them to the glaſſes. No. 3. Is a little hair-bruſh or pencil to duſt the glaſſes, or to take up ſmall drops of liquid, to put them upon the talc or iſinglaſs, to be examined. No. 17. Is a glaſs tube to confine a frog, or other living object, in order to diſcover the circulation of the blood.

Theſe particulars are depoſited in a ſmall box fit for the pocket. And now, as to the management of this inſtrument.

When an object is to be viewed, thruſt the ivory ſlider with the object, between the plates E E, putting that ſide of the ſlider where the braſs rings are, fartheſt from your eye. Then ſcrew on the glaſs at G ; and, looking through it againſt the light, turn the long ſcrew C C, till your object be brought to fit your eye diſtinctly and clearly.—The moſt curious inſpectors view their objects firſt with a magnifier, that diſcovers the whole at once ; and then, with one of the greateſt magnifiers, examine every part ſeparately ; which is done by gently moving the ſlider, which contains the object : but if any part ſhould be out of diſtance, the ſcrew C C will eaſily bring it to the true *focus*. If you want to change your objects, it is done by picking out the braſs rings that confine the talc, with the point of a penknife ; and faſtening the new ones with the ſame rings replaced. If your object be a ſmall fiſh in the tube, ſpread its tail and fins againſt the ſides thereof : if a frog, expand with a quill the tranſparent membrane between the toes of its hind foot, as much as poſſible, and adjuſt it ſo as no part thereof ſhall intercept the light from the place to be viewed. Thruſt the tube into the arched cavity, quite through the body of the microſcope, and then ſcrew it by the ſcrew C C, to the true focal diſtance, and the blood will appear paſſing through the veſſels in a moſt ſurpriſing manner. For theſe two objects uſe the third or fourth magnifier.

This microſcope is ſo contrived as to form a *double one*, by ſcrewing it to a tube with an eye-glaſs at the end thereof : and it may alſo nearly anſwer the purpoſes of the *large double reflecting microſcope*, thus ;

Fig. II. A is a braſs ſtalk fixed on the wooden baſis B. C is a ſcrew, which ſecures the microſcope D faſt to the ſtalk. F, a concave looking-glaſs in a braſs box hanging in the arch G by ſmall ſcrews *f f* entering its oppoſite ſides. And at the bottom of the arch is a braſs pin, exactly fitted to a hole in the pedeſtal, ſo that, by this twofold motion, the *ſpeculum* may be eaſily adjuſted to reflect the light of the ſky, ſun, or candle directly upwards through the microſcope fixed perpendicularly over it ; and anſwer all the ends of the *double reflecting microſcope :* of which particularly in the next place.

Fig. III. Is an alteration and improvement of Mr. *Marſhall*'s *large double microſcope*, ſo as to be more manageable, and to ſhew objects in a clearer and more pleaſing manner. A A A A make a large tube ſupported by three braſs pillars *b b b*, fixed in a wooden baſis C, in which is a drawer D to hold neceſſaries : *e e* make a leſſer tube, which ſlides into the greater, and ſends from its bottom a ſmaller tube *f*, with a male ſcrew *g*, on which is ſcrewed the object glaſs or magnifier. *Note*, There are five magnifiers numbered 1, 2, 3, 4, 5, of which the greateſt have the ſmalleſt apertures and loweſt numbers ; which numbers are alſo marked on the inner tube, to direct whereabout to place it according to the magnifier made uſe of : but if then it fits not the eye exactly, ſlide the inner tube *e e* gently higher or lower, or turn the ſcrew of the magnifier gradually, till the object appears diſtinct. L is a circular plate of braſs fixed horizontally between the three braſs pillars, with a round hole M in the center, adapted to receive the contrivance No. 22. for holding ivory ſliders for the placing of objects ; which contrivance conſiſteth of a ſpiral ſteel wire confined between three braſs circles, one of which is moveable for the admiſſion of the ſlider. No. 13. Is a round braſs plate with ſeveral holes for placing objects in ; at the bottom of which is a button to ſlip into a ſlit P or

on the circular braſs plate of *fig.* III. and by turning it round on this pin, all the objects may be examined ſucceſſively with very little trouble. *Note*, Two of theſe holes are generally reſerved for ſmall concave glaſſes to receive a drop of liquid, in order to view the animalcules, *&c.* And the more curious will be provided with a piece of white ivory to receive black opake objects; and a piece of ebony to receive ſuch as are white, made of the ſame ſize and ſhape as the contrivance No. 13.

Q is a concave looking-glaſs in a braſs box, and turning in the arch R upon two ſmall ſcrews *s s*. And by virtue of a pin *t* at the bottom of the arch, and fixed in the center of the baſis, this glaſs is made to turn vertically, or horizontally, and to reflect the light of the ſun, ſky, or candle, directly upwards on the object to be viewed.

No. 20. Is a plano-convex *lens*, which in plain day-light is of no uſe; but of good ſervice to point the light of a candle, or the ſun-ſhine, upon any opake body to be examined. It turns on two ſcrews, and the pin at the bottom is placed in the hole M in the center of the circular plate of *fig.* III. and it may be removed higher or lower as the light requires.

As experience teacheth, that very tranſparent objects are rendered more diſtinctly viſible by intercepting ſome part of the oblique rays reflected from the rays of the looking-glaſs: ſo in viewing them, it is adviſed to faſten the contrivance No. 21, a cone of black ivory, on a ſhank underneath the braſs circular plate L, eſpecially when the firſt or ſecond magnifier is made uſe of.

No. 12. Is called a *braſs fiſh-pan*, and ſerves to preſent the object of a ſmall fiſh, which muſt have its tail ſpread acroſs the oblong hole at the ſmalleſt end of the pan: then by ſlipping the button on the back-ſide of the pan into the ſlit P of *fig.* III. the ſpring, which comes from the button, will preſent it right to view and keep it ſteady. But if the object be a frog, a newt, or an eel, uſe the glaſs tube No. 17. deſcribed under *fig.* I. which here muſt ſlide under the circular plate L. where there are two ſprings and a cavity made in the ſhank to hold it, till the object is brought directly under the magnifier. *Note*, In all theſe caſes of live animals, the leſs room the creature has to move in, it will be the more eaſily examined. The next contrivance peculiar to this microſcope is the cell No. 7. which contains a concave and a plain glaſs, and is intended to confine fleas, lice, mites, or any other ſmall living objects. It is to be placed over the hole M.

The hole near the edge of the plate L, ſerves to receive a braſs ſhort tube with a button faſtened to it, and contains a long ſteel wire with a pair of plyars at one end, and a point at the other, as deſcribed by No. 5. to hold faſt, or ſtick objects on. By which contrivance, the object may be readily brought to a right poſition towards either the looking-glaſs or the plano-convex *lens*.

The *ſliders* are made according to the ſpecimen No. 1. deſcribed in *fig.* I. So are alſo the hair *bruſh* No. 3. and the *nippers* No. 19. But, when you uſe ſliders in this microſcope, thruſt them between the braſs rings of No. 22. whoſe uſe is deſcribed above, which will keep them ſteady, and permit them alſo to be moved for convenience.

Fig. IV. Is a repreſentation of the *compound microſcope*, which is a great improvement upon the *double* or *reflecting microſcope*: for which improvement we are indebted to Mr. *Aſcough*, Optician, in *London*; who, juſtly conſidering that the chief excellency of ſuch an inſtrument conſiſts in the degree of the magnifying power under which the objects may be ſeen with diſtinctneſs; and in the ready and moſt convenient placing of the object to be viewed; have paid particular regard to the moſt advantageous ſitu-

ation

ation of the glaſſes in the ſtructure of this *new* microſcope.

A repreſents the box, in which is contained all the apparatus, when packed up for carriage, and ſerves for a baſe or pedeſtal to ſupport the inſtrument when erected for obſervation. On the top of this box is faſtened a braſs plate or dove-tail, which the baſe of the braſs pillar B ſlides on, and is thereby fixed immoveable.

Note. Take off the braſs plate which ſlides over the dove-tail, to preſerve its edges, before you can erect the pillar.

C is the body of this microſcope, fixed in a circular collar at *a a*, and may be taken in and out at pleaſure. See you fix it tight. D is a horizontal plate or ſtage, on which any of the parts for holding the objects for obſervation are placed. It may be taken off at *b*, and is fixed to a ſquare braſs collar, which moves up and down the pillar, to render it more eaſy in its motion for adjuſting, the body C being fixed without any motion. And on the top of this ſtage is a thin round plate, under which the ivory *ſliders* muſt be placed, it being made with a proper ſpring, ſo as to give way for their reception : and under the ſtage is a proper cavity which ſprings in the ſame manner, to receive a glaſs *tube*. Of which parts we have ſaid enough at No. 1. and No. 17. in *fig*. I.

F is a ſemicircular braſs frame incloſing a concave and a plain glaſs, which, properly directed, throws up the light to the object fixed on the ſtage.—The ſtem of this ſemicircle muſt be fixed in the hole 1 or 2, as the obſerver chuſes. Though, it is thought, the three greateſt magnifiers will require it at 1.

G Is a double convex *lens*, which, turning on two ſcrews, tranſmits light to examine opake objects. The long cylindrical part *c*, is placed in the ſpring-tube *d*, faſtened to one corner of the ſtage.

The ſame *ſliders* and *tube* for viewing different objects are uſed in this, as in the ſingle microſcope, where they are deſcribed under No. 1, 17.

No. 18. Is a long wire with a worm at one end, contrived to pull out the cotton kept in the tubes to prevent their breaking, and to clean them with cotton, when neceſſary. No. 16. Is a ſmall *lens* or magnifier in a braſs cell, which is made to ſcrew on at the end of the braſs ſnout at K, of which glaſſes there are ſix of different *focus*'s, to be uſed at diſcretion, according to the ſize of the object. No. 10. Is a braſs cone to faſten in the ſhank under the middle of the ſtage, when any very tranſparent objects are viewed with the 1ſt, 2d, or 3d magnifiers (See No. 21. *fig*. III.) particularly in viewing the circulation of the blood. No. 2. Is a hollow cylinder with its ſides open ; to the end of which is ſcrewed a concave ſilver *ſpeculum b*, having a round hole in the middle of it. This cylinder ſliding over the ſnout of the microſcope *m*, and the top edge ſet to the mark correſponding with the mark on the magnifier uſed, a ſtrong light becomes reflected from the ſilver *ſpeculum* on any opake body under examination. The concave or plain mirror, in this as well as in all other obſervations, may be either of them uſed as you like beſt. No. 5. Is the long ſteel wire with a pair of pincers, deſcribed in *fig*. III. Here it ſlides backwards and forwards in a ſpring tube *n*, faſtened to a joint with a ſhort ſhank that puts into a round hole of the ſlit in the ſtage D.

No. 4. Is a little block of ivory, white at one end, and black at the other, for objects to be placed on according to their colours, with a hole through the middle, to ſtick it on the point of the wire 5. On this block, ſalt, ſand, or ſuch like objects, are fixed with gum, if they will not lie otherwiſe. No. 7. Is a round box to confine ſmall inſects between two glaſſes, one of which is concave, the other plain. This box or cell muſt be placed over the hole in the center of the ſtage, firſt having the hole covered with the plain glaſs, No. 6. and then move it about till you bring the object exactly under

under the magnifier. No. 8. Is a concave glaſs, in which any liquid to be examined may be dropped. No. 9. Is a hand magnifier, very uſeful for preparing objects for the microſcope, or for the examining coins, medals, or any kind of engravings.

After this deſcription of the ſtructure, and the method of uſing theſe microſcopes; I ſhall now give you a table of the magnifying powers of the ſingle microſcope, as calculated by Mr. *Henry Baker*, F. R. S.

A Table *of the Magnifying Powers of* Convex Glaſſes, *employed in ſingle* Microſcopes, *according to the Diſtance of their* Focus *Calculated by the* Scale of an Inch, *divided into an Hundred Parts.*

Shewing how many times the *Diameter*, the *Superficies*, and the *Cube* of an Object is *magnified*, when viewed through ſuch *Glaſſes*, to an Eye whoſe natural Sight is at *eight Inches*, or eight-hundred of the hundredth Parts of an Inch.

The Focus of a Glaſs at	Hundred Parts of an Inch:	*Magnifies the* Diameter,	*Magnifies the* Superficies,	*Magnifies the* Cube *of an Object*,	
$\frac{1}{2}$, or	50	16	256	4,096	Times.
$\frac{4}{10}$, or	40	20	400	8,000	
$\frac{3}{10}$, or	30	26	676	17,576	
$\frac{1}{5}$, or	20	40	1,600	64,000	
	15	53	2,809	148,877	
	14	57	3,249	185,193	
	13	61	3,721	226,981	
	12	66	4,356	287,496	
	11	72	5,184	373,248	
$\frac{1}{10}$, or	10	80	6,400	512,000	
	9	88	7,744	681,472	
	8	100	10,000	1,000,000	
	7	114	12,996	1,481,544	
	6	133	17,689	2,352,637	
$\frac{1}{20}$, ‡ or	5	160	25,600	4,096,000	
	4	200	40,000	8,000,000	
	3	266	70,756	18,821,096	
$\frac{1}{50}$, or	2	400	160,000	64,000,000	
	1	800	640,000	512,000,000	

‡ The greateſt magnifier in Mr. *Lewenhock*'s cabinet of microſcopes, preſented to the *Royal Society*, has its *Focus*, as nearly as can well be meaſured, at one *twentieth* of an inch diſtance from its center, and conſequently magnifies the *diameter* of an object 160 times, and the *ſuperficies* 25,600. But the greateſt magnifier in Mr. *Wilſon*'s ſingle microſcopes, as they are now made, has uſually its *Focus* at no farther diſtance than about the *fiftieth* part of an inch; whereby it has a power of enlarging the *diameter* of an object 400, and its *ſuperficies* 160,000 times.

Of proper Objects *for the* Microſcope.

The next care is to inſtruct the beginner in philoſophical enquiries by the microſcope, to chuſe proper *objects*. Theſe, according to Dr. *Hooke*, are *exceeding ſmall* bodies, *exceeding ſmall* pores, or *exceeding ſmall* motions. And under

under one or other of theſe heads, almoſt every thing about us affords matter of examination, and conduces to amuſement and inſtruction. For, under exceeding ſmall *bodies*, we are to underſtand, either the minute parts of larger bodies; or ſeeds, inſects, ſand, *&c.* By exceeding ſmall *pores* are pointed out the interſtices between the ſolid parts of bodies, as in ſtones, minerals, ſhells, *&c.* or the mouths of minute veſſels in vegetables; the pores in the ſkin, bones, *&c.* of animals. And under exceeding ſmall *motions* are reduced the movements of the ſeveral parts or members of minute animals, or the motion of the fluids, contained either in animal or vegetable bodies.

But Mr. *Benjamin Martin* is more particular, and furniſheth us with a curious collection of *microſcopic objects*, viz. human *hair*, hair of horſes and mice; hogs-*briſtles*, and *ſmellers* of cats, tigers, leopards, *&c.* The *cuticle*, or *ſcarf-ſkin* of an human body; the *ſkin*; the *membrana adipoſa*, which lies next under the ſkin; *muſcular fibres*, *nerves*, *arteries*, and *veins*; the *inteſtines* or *guts*; the *lacteals*, or fine ducts of the *chyle*; the *lymphaducts*; the *lungs*, *liver*, *kidnies*, *pancreas*, *ſpleen*, &c. the *ſeminal* veſſels, *teſticle*, and *penis*; the *brain*, *eye*, *noſe*, *ear*, and *tongue*, with all their peculiar parts and contents. But the blood of man, or beaſt, yields the ſublimeſt ſpeculations; the *ſemen*, or the infinitely ſmall and numerous *animalculæ* in all male ſperm, are the moſt aſtoniſhing ſpectacles; and as yet the higheſt attainment of the microſcope. To which he adds the *urine*, *bones*, *nails*, and *hoofs* of beaſts.

Amongſt the objects peculiar to *birds*, the firſt thing, ſays he, which preſents itſelf for a microſcope view, are the *feathers*, eſpecially of the jay, the pheaſant, the peacock, the mallard, which are ſurprizingly delightful to the eye. Each *plumula*, by this inſtrument, aſſumes the appearance of a large feather. The red *combs* and *gills* of a cock, and the *ſcaly ſkins* of the legs; the web in the feet of water-fowl are all proper objects. The *fleſhy fibres* in general, but more eſpecially the gizzard dried and cut into pieces, ſhews a wonderous mechaniſm. The *bill* of large birds, and the *plates* of the *ſkull*; the *interſtices*, with the bony *fibrillæ* which connect theſe plates, are curious ſubject of enquiry. The *egg*, in all its parts, is the moſt copious ſource of microſcopic themes belonging to this tribe.

The objects, peculiar to *fiſhes*, afford great pleaſure. No perſon unacquainted with the microſcope can imagine what a glorious and beautiful creature a *fiſh* is.

Were it poſſible to view the whole body of the *carp*, as magnified by a microſcope, it muſt be pronounced the fineſt animal that was ever ſeen. The *ſcales* appear beſpangled with ſtars like gold, interſperſed with a great number of beautiful ſpecks and ſpots. The ſcales of an eel are perfectly tranſparent; but in order to procure theſe, you muſt take a piece of the ſkin from the ſide, and ſpread it very ſmooth, while moiſt, upon a glaſs; then the ſcales will diſcover themſelves under a ſort of cuticle, which, being raiſed up with the point of a penknife, opens a paſſage for the ſcales, which will then eaſily ſlip out. And indeed, the ſkin of all fiſh is very pleaſing to behold in the microſcope. But the *ſkin* which covers the *ſaw* of the *ſaw-fiſh*, is a moſt curious object.

The *fins* of fiſhes are a wonderous ſubject, for they are beautifully coloured, and ſtellated beyond any other part. *Note*, in the fins and tails of fiſhes, the circulation of the blood is moſt particularly diſcovered.

The *fleſhy fibres* of fiſh, particularly of crabs and lobſters, reſemble a piece of fine linnen.—The *ſperm*, or *hard roe* of fiſhes, appears to be an *ovarium* of eggs. The *teeth*, particularly of eels, yield a delightful view; as do alſo the *brain*, the *nerves*, the *eyes*, *lungs*, *viſcera*, *gills*, and their ſhells.

Amongſt *inſects*, in the *butterfly* every part is wonderful and delightful through a microſcope.—The *bee*, *hornet*, *waſp*, and *humble-bee* are no leſs curi-

curious, examined in all their parts. All ſorts of *flies*, *gnats*, *crickets*, *beetles*, *lady-birds*, *earwigs*, *lice*, *mites*, *ſpiders* and their *eggs*, *ants*, and all ſorts of *water inſects*, that either live wholly in the water, or only play on the ſurface, will afford an infinite variety to the curious obſerver.

Amongſt the *creeping* things we principally recommend the *Indian centipede*, the *noctiluca*, the *glow-worm*, the *cheſs-bug*, or *wood-louſe*, *maggots* hatched from the *eggs* of inſects and found in the earth or rotten trees: the *caterpillers* of various kinds, the *cadas-worm*, *cod-baits*, *ſtraw-worms*, &c. the *viper*, or *adder*, the *ſnake*, the *ſlow-worm*, *earth-worms*, and *ſnails*.

Amongſt *plants* and *vegetables*; the *barks* of trees, eſpecially of the *plum*, *cherry*, *beech*, &c. the branch of a *vine* cut into thin ſlices, the *ſtem*, *trunks*, and *roots* of other trees, cut in the ſame manner; *touch-wood*; the *gems* or *buds*; the *leaves* and *bloſſoms*; the *flowers*, *fruit*, and *ſeeds* of plants; *muſhrooms*, *puff-balls*, *truffles*, *Jews-ear*, and all other moſſy and fungous excreſcences. In fine, the *flower* of graſs and corn, the *beard* of *wheat*, *rye*, and eſpecially *barley*; the *Iuli*, or catkins of *haſle*, *willow*, &c. with a thouſand other adjuncts, will offer themſelves to the view and admiration of any one, who ſhall undertake to enquire into the numberleſs curioſities of the vegetable world *.

Theſe are the claſſes into which *microſcopic* objects are reduced by the learned: but it is alſo acknowledged, that there are others of a *miſcellaneous* claſs, which cannot be ranked with any of the foregoing, though they afford great variety and pleaſure to the inſpector; and are all thoſe *animalcula*, which are found in vinegar and water, wherein *pepper*, *fleſh*, *leaves*, or any other ſubſtance has been ſteeped for ſome days in the ſummer ſeaſon: and to theſe may be added *ſponge*, which is a ſubmarine moſs or plant, and view'd in the microſcope, diſcovers ſuch a compoſition and texture of parts, as are equally full of wonder and entertainment: and *ſea-water* evaporated on a piece of glaſs, over a gentle fire, and laid under a microſcope, will preſent a clear view of the particles, which compoſe our common ſalt, in their ſimple natural ſtate. Pieces of any ſort of *linnen*, *ſilk*, *ribbon*, *cotton*, *ſand*, *tinder* lighted; *filings* of *ſteel*; *ſnow*, *ice*, the hoar *froſt*; various ſorts of *ſtones*, *foſſils*, &c. *drugs*, *chemical* preparations; *brandy*, and all ſorts of ſpirits have their diſtinct beauties thro' a microſcope.

And to give you a more clear idea of what may be expected by the diſcoveries of this inſtrument, the microſcope, I have delineated a few objects within the line at the top of the copper-plate, where No. 23, 24, 25, 26, 27, 28, 29, 30 are repreſentations of animalcules diſcovered by the microſcope in ditch water; as we are informed by the *Philoſ. Tranſ.* No. 283.

In fine, to borrow the words of the ingenious Gentleman, and philoſophic genius above referred to:

Each ſeed includes a plant, the plant, again
Has other ſeeds, which other plants contain;
Thoſe other plants have all their ſeeds; and thoſe
More plants, again, ſucceſſively incloſe.
Thus every ſingle berry that we find,
Has really, in itſelf, whole foreſts of its kind:
Empire and wealth, one acorn may diſpenſe,
By fleets to ſail a thouſand ages hence.
Each myrtle-ſeed includes a thouſand groves,
Where future bards may warble forth their loves.
So ADAM's *loins contain'd his large poſterity,*
All people that have been, and all that e'er ſhall be.
Amazing thought! what mortal can conceive
Such wond'rous ſmallneſs!—yet we muſt believe

What

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* *Mr.* Ayſcough, Optician, *in* Ludgate-Street, *has always large Collections of Variety of curious Objects ready fitted in Ivory Sliders.*

What reaſon tells; for reaſon's piercing eye
Diſcerns thoſe truths, our ſenſes can't deſcry.
See BAKER's *Poem,* the *Univerſe.*

Directions for examining Objects, *or for the right Uſe of the Microſcope.*

An examination of objects, in order to diſcover truth, requires a great deal of attention, care, and patience, together with ſome conſiderable ſkill and dexterity (to be acquired by practice chiefly) in the preparing, managing, and applying them to the microſcope.

When any object comes to be examined, the ſize, the contexture, and nature of it ſhould be duly conſidered; in order to apply it to ſuch glaſſes and in ſuch a manner as may ſhew it beſt. The firſt ſtep towards this conſtantly ſhould be, to view it through a magnifier that can take in the whole at once: for by obſerving how the parts lie as to one another, we ſhall find it much eaſier to examine and judge of them ſeparately, if there be occaſion.—After having made ourſelves acquainted with the form of the whole, we may divide it as we pleaſe, and the ſmaller the parts into which it is divided, the greater muſt be the magnifiers wherewith to view them.

The tranſparency or opakenenefs of an object muſt alſo be well regarded, and the glaſſes made uſe of muſt be accordingly ſuited thereto; for a tranſparent object will bear a much greater magnifier than one which is opake; ſince the nearneſs a glaſs that magnifies much muſt be placed at, unavoidably darkens an opake object, and prevents its being ſeen, unleſs by the microſcope on purpoſe for ſuch ſubjects. Moſt objects, however, become tranſparent by being divided into extreamly thin or minute parts. Contrivance therefore is neceſſary, to reduce them into ſuch thinneſs or ſmallneſs, as may render them moſt fit for examination.

The nature of the object, whether it be alive or dead, a ſolid or a fluid, an animal, a vegetable, or a mineral ſubſtance, muſt likewiſe be conſidered, and all the circumſtances of it attended to, that we may apply it in the moſt convenient manner. If it be a living animal, care muſt be taken to ſqueeze, hurt, or diſcompoſe it as little as poſſible, that its right form, poſture, and temper may be diſcovered. If a fluid, and too thick, it muſt be thinned with water: if too thin, we ſhould let ſome of its watery parts evaporate. Some ſubſtances are fitteſt for obſervation when dry, others again when moiſtened; ſome when freſh, and ſome after being kept a while.

Light is the next thing to be taken care of, for on this the truth of all our examinations depends; and a very little experience will ſhew, how different objects appear in one poſition and kind of it, to what they do in another. So that we ſhould turn them every way, and view them in every degree of light, from brightneſs even to obſcurity; and in all poſitions to each degree; till we are certain of their true form, and that we are not deceived. For, as Mr. *Hooke* ſays, in many objects it is very difficult to diſtinguiſh between a prominency and a depreſſion; between a ſhadow and a black ſtain; and in colour, between a reflection and a whiteneſs. The eye of a fly, for example, in one kind of light, appears like a lattice drilled through with abundance of holes; in the ſun-ſhine, like a ſurface covered with golden nails: in one poſition like a ſurface covered with pyramids; in another with cones; and in other poſitions of quite other ſhapes.

The degree of light muſt be duly ſuited to the object; which, if dark, will be ſeen beſt in a full and ſtrong light; but if very tranſparent, the light ſhould be proportionably weak: for which reaſon there is a contrivance, both in the ſingle and double microſcope, to cut off abundance of its rays, when ſuch tranſparent objects are examined by the greateſt magnifiers.

The light of a candle, for many objects, and eſpecially ſuch as are exceedingly

ceedingly minute and tranſparent, is preferable to day-light; and for others, day-light is beſt: I mean the light of a bright cloud. As for ſunſhine, it is reflected from objects with ſo much glare, and exhibits ſuch gaudy colours, that nothing can be determined by it with certainty: and therefore it is to be accounted the worſt light that can be had.

Moſt objects require ſome management, in order to bring them properly before the glaſſes.—If they are flat and tranſparent, and ſuch as will not be injured by preſſure, the beſt method is to incloſe them in ſliders, between two *Muſcovy* talcs or iſinglaſs. This way the feathers of butterflies, the ſcales of fiſhes, the *farinæ* of flowers, *&c.* the ſeveral parts, and even whole bodies of minute inſects, and a thouſand other things, may very conveniently be preſerved.

In making a collection of objects, the ſliders ſhould not be filled promiſcuouſly, but care taken to ſort the objects according to their ſize and tranſparency, in ſuch manner, that none be put together in the ſame ſlider, but what may properly be examined by the ſame magnifier: and then the ſlider ſhould be marked with the number of the magnifier, its objects are fitteſt for; that is, the moſt tranſparent, or minuteſt objects of all, which require the firſt magnifier to view them by, ſhould be placed in a ſlider, or ſliders, marked with No. 1. Thoſe of the next degree in ſliders marked with No. 2. and ſo of the reſt.

Small living objects, ſuch as lice, fleas, gnats, ſmall bugs, minute ſpiders, mites, *&c.* may be placed between theſe talcs, without killing or hurting them, if care be taken not to preſs down the braſs rings that keep in the talcs; and will remain alive even weeks in this manner. But if they are larger than to be treated thus, either put them in a ſlider with concave glaſſes, or elſe examine them ſtuck on the pin, or held between the plyers; either of which ways they may be viewed at pleaſure.

If fluids come under examination, to diſcover the animalcules that may be in them, take up a ſmall drop with your pen or hair-pencil, and place it on a ſingle iſinglaſs (which you ſhould have in a ſlider ready) or elſe in one of the little concave glaſſes, and ſo apply it. But in caſe, upon viewing it, you find, as often happens, the animalcules ſwarming together, and ſo exceedingly numerous, that running continually over one another, their kinds and real form cannot be known; ſome part of the drop muſt be taken off the glaſs, and then a little fair water, put to the reſt, will make them ſeparate, and ſhew them diſtinct and well. And this mixture of water is particularly requiſite in viewing the *ſemen maſculinum* of all creatures.

But, if we view a fluid, to find what ſalts it may have in it, a method quite contrary to the foregoing muſt be employed: for, then, the fluid muſt be ſuffered to evaporate, that the ſalts, being left behind upon the glaſs, may more eaſily be examined.

Another, and indeed the moſt curious way of examining fluids, is, by applying them to the microſcope, in exceedingly ſmall capillary tubes made of the thinneſt glaſs poſſible, for diſcovering the ſhapes of ſalts floating in vinegar, wine, *&c.*

To diſſect minute inſects, as fleas, lice, gnats, mites, *&c.* and view their internal ſtructure, requires a great deal of patience and dexterity; yet even this may be done, in a very ſatisfactory manner, by means of a fine lancet and needle, if they are placed in a drop of water: for their parts will then be ſeparated with eaſe, and lie fair before the microſcope, ſo that the ſtomach and other bowels may plainly be diſtinguiſhed and examined.

We ſhould always have ready, for this purpoſe, little ſlips of glaſs, about the bigneſs of a ſlider, to place objects on occaſionally; ſome of which ſlips ſhould be made of green, blue, and other different coloured glaſs; many objects being much more diſtinguiſhable when placed on one colour than ano-

another. We ſhould likewiſe be provided with glaſs-tubes of all ſizes, from the fineſt capillaries, that can be blown, to a bore of half an inch diameter.

Cut cards into ſmall ſlips, about half an inch in length, and the tenth of an inch broad; wet them half their length with a ſtrong, but very tranſparent gum-water, and with that ſtick on your object. As the ſpots of cards are red and black; by making your ſlips of ſuch ſpots, you will obtain a contraſt to objects of almoſt any colour; and by fixing black things on the white, white on the black, blue or green on the red or white, and all other coloured objects on ſlips moſt contrary to themſelves, they will be ſhewn to the beſt advantage. Theſe ſlips are to ſhew opake bodies.

Beware of determining and declaring your opinion ſuddenly on any object. Remember that truth alone is the matter you are in ſearch after.

Paſs no judgment upon things over extended by force, or contracted by dryneſs, or in any manner out of their natural ſtate, without making ſuitable allowances.

There is no advantage in examining any object with a greater magnifier than what ſhews the ſame diſtinctly; and therefore, if you can ſee it well with the third or fourth glaſs, never uſe the firſt or ſecond; for the leſs a glaſs magnifies, the better light you will have, the eaſier you can manage the object, and the clearer it will appear.

Some people have made falſe pretences and ridiculous boaſts, of ſeeing, by their glaſſes, the atoms of *Epicurus*, the ſubtile matter of *Des Cartes*, the effluvia of bodies, the emanations from the ſtars, and other ſuch like impoſſibilities: but let no ingenious and honeſt obſerver give credit to theſe romantic ſtories, or miſpend his time, and bewilder his brains, in following ſuch idle imaginations, when there lies before him an infinity of real objects, that may be examined with eaſe, profit, and delight.

OCCASIONAL LETTERS.

LETTER X. *To* WILLIAM HENRY, *Earl of* Bath, *at the Camp in* Flanders, 1707.

EVERY living creature, my dear Lord, is intitled to offices of humanity: the diſtreſs even of an enemy ſhould reconcile us to him: if he thirſts, give him drink; if he hungers, give him food: overcome evil with good. It is with this diſpoſition I would have you enter into the exerciſe of that authority, Lord-lieutenant of *Cornwall*, with which her Majeſty has honoured you over your countrymen. Let no body inſpire you with party prejudices and reſentments. Let it be your buſineſs to reconcile differences, and heal diviſions, and to reſtore, if poſſible, harmony and good neighbourhood amongſt them. If then there ſhould be any left to uſe you ill, make them aſhamed and confounded with your goodneſs and moderation; not that I would ever adviſe you to ſacrifice one hair of the head of an old friend to your family, to gain fifty new ones; but if you can increaſe the number by courteſy and moderation, it may be worth the trial. Believe me, my dear Lord! humanity and generoſity make the beſt foundation to build a character upon. A man may have birth, riches, and power; wit, learning, and courage; but without generoſity, it is impoſſible to be a great man. Whatever the rich and powerful may think of themſelves, whatever value they may ſet upon their abundance and grandeur, they will find themſelves but the more hated and deſpiſed, for the ill uſe they make of it.

You ſhould look upon yourſelf but as a ſteward and truſtee for the diſtreſſed. Your over abundance is but to depoſit for the uſe and relief of the

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